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(54) Method for the continuous painting of moving elements and relative device

(57) Method for the continuous painting of moving elements, which is suitable advantageously, but not only, for the painting of elements of a rod-shaped type being fed along their longitudinal axis, such as strips for frames in particular, the method being especially suitable for the painting of elements having a variously shaped or moulded profile, the method including one or more applications of paint on the element (18) to be painted, a brushing step and a step of drying with ultraviolet rays, the paint being of a photosensitive type with a substantially 100% dry residue, the method comprising in sequence a first step of application of a first layer of paint on the element (18) to be painted, a step of removal, levelling and spreading of that first layer of paint on the surface of the element (18) to be painted and at least one second step of application of a second layer of paint, these three steps being followed by the step of drying with ultraviolet rays.

Device for the continuous painting of moving elements, which is suitable advantageously, but not only, for the painting of elements of a rod-shaped type, such as strips for frames in particular, which are fed along their longitudinal axis, the device (10) being especially suitable for the painting of elements (18) having a variously shaped or moulded profile, the device (10) cooperating downstream with means for drying with ultraviolet rays and comprising means (11) for the continuous feeding of the elements (18) to be painted, the device (10) including a box-shaped structure (14) defining a substantially closed painting chamber, within which are contained at least two spraying assemblies (15-17), each spraying assembly (15-17) comprising a plurality of adjustably positionable spray guns (19) to deliver paint, the device (10) comprising at least one first spraying assembly (15), at least one first assembly (16) for the removal, levelling and spreading of the layer of paint and at least one second spraying assembly (17) arranged in sequence.

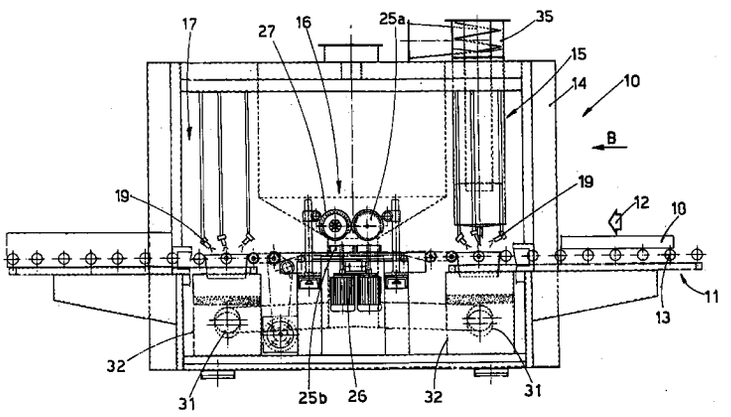

fig.2

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Description

This invention concerns a method for the continuous painting of moving elements and the relative device, as set forth in the respective main claims.

This invention is applied advantageously to linear machines pre-arranged for the continuous painting of elements of a substantially rod-shaped type, such as strips for frames or other like elements.

The invention is especially suitable for the painting of strips of wood or other materials for frames, where the strips have a profile characterised by shapings, mouldings, steps, hollows, consecutive ridges and/or grooves.

The invention can be used also for the painting of plastic or metallic elements or elements consisting of any other like material.

The state of the art covers linear painting machines for the continuous painting of moving elements such as rods, strips, flat objects, frames, etc.

The normal painting machines include a conveyor belt which feeds the piece to be painted to one or more spraying assemblies positioned in sequence within a substantially closed painting chamber.

Each spraying assembly comprises a plurality of adjustably positionable spray guns able to deliver the paint over the whole periphery of the element to be painted.

The painting machines of the state of the art generally include aspiration means associated with filtration means positioned downstream.

The aspiration means aspirate the vapours of paint produced during the spraying step, while the filtration means separate the air from the component of paint so as to be able to discharge that air into the outside environment.

The paints normally used in the painting machines of the state of the art are of a type with a solvent and with a low component of dry residue.

These paints containing a solvent are characterised by requiring a long drying period after the application of the coat of paint on the element to be painted.

A drying oven is generally positioned downstream of the painting machine, and in this oven the elements leaving the painting process are stacked, held and left for a variable length of time according to the profile and the material of which the painted element consists and according to the type of paint, the finished quality of the product, etc.

A common drying process provides for the painted elements to be left in the furnace for about half an hour at a temperature of about 50 to 60°C.

Other drying processes do not require the inclusion of an oven, and the painted elements are left to dry at the ambient temperature for periods which may reach even two hours.

According to another drying processes the painted elements undergo a first drying at the ambient temperature for a determined period and then a completion of the drying inside the oven.

It is clear that these painting processes with a successive drying, even though they enable a product of a good quality to be produced, entail long execution periods, great space occupied, difficulty of management in terms of the entry of the elements into, and their exit from, the oven at the correct times, and also downtimes, complex conveying systems, a waste of energy, etc.

Moreover, the use of paints containing solvents entails serious pollution problems and therefore the necessity to provide sophisticated means to abate the polluting component, to separate that component from the air and to be able to release the filtered air into the environment.

Furthermore, the use of paints containing a solvent involves a considerable waste of paint since a great component of the liquid residue is lost by evaporation.

All these problems have caused manufacturers in this field to use paints which contain no solvent and which can be dried downstream with a system of ultraviolet rays.

If such paints are employed, the coat of paint applied is dried downstream of the painting machine by being lapped by ultraviolet rays substantially without interrupting the forward movement of the painted element.

Appreciable results are achieved with this method in terms of the time employed in carrying out the painting cycle, and there is no need for storage, nor is there any difficulty in handling the painted elements downstream of the painting machine.

Moreover, it is possible to achieve an almost total use of the paint employed since substantially no evaporation takes place.

A further advantage is linked to the environmental factor inasmuch as these paints do not include an appreciable polluting component and therefore there is no need to use complex systems to abate the fumes.

The employment of such a painting method, however, entails a decline of the finished quality of the painted product.

In fact, it has been found that, if even a partial step of evaporation of the paint during the very first phase of application to the element to be painted is not included, there is not a uniform and homogenous distribution of the layer of paint over the whole surface of the element itself.

In particular, if there are elements having a profile characterised by consecutive hollows and corners or by mouldings, grooves or other shapes such as those generally found in strips for frames, a running of the paint generally takes place and leads to a lack of uniformity in the layer of paint and also to a build-up of paint or, alternatively, a lack of paint over the conformation of the profile.

A lack of paint in certain zones of the profile may lead, during the honing step, to almost complete removal of the paint and may therefore make it neces-

sary to send the element back to the painting cycle after the honing step.

Besides, particularly in the painting of wooden elements, the paint is deposited and builds up in the structural pores and grains of the element, thus often forming bubbles and clots which the lack of even a minimum step of evaporation cannot eliminate.

The presence of build-ups of paint in the drying step makes it impossible for the ultraviolet rays to penetrate the surface layer of paint, and thus zones and/or points are formed where the paint below the surface layer remains substantially liquid. This situation causes a considerable worsening of the quality of the finished painted element, but this worsening does not counterbalance the aforesaid great working advantages entailed by using these paints with ultraviolet-ray drying.

The state of the art also covers a step of brushing the surface of the element to be painted as it leaves the painting chamber. This brushing, which is normally carried out by using brushes with a low speed of rotation, has the sole purpose of spreading the layer and bringing the paint to the points which the action of the spray guns has been unable to reach.

The present applicants have therefore set themselves the objective of obtaining a method and the relative device which enable photosensitive paints to be used with drying by means of ultraviolet rays, thus achieving the aforesaid working advantages without thereby entailing a decline of the quality of the finished product as compared to what can be achieved with conventional paints containing a solvent; for this purpose the applicants have designed, tested and embodied this invention.

This invention is set forth and characterised in the respective main claims, while the dependent claims describe variants of the idea of the main embodiment.

The purpose of the invention is to obtain a painting method which is particularly, but not only, suitable for wooden elements of a rod-shaped type such as strips for frames or like elements, the method making possible the use of paints which can be dried with ultraviolet rays with a consequent high quality of the finished product.

The method is associated with means to convey and feed the rod-shaped elements to be painted, this feed being parallel to the longitudinal axis of the element.

The conveyor means can be conveyor belts, roller conveyors, conveyor elements on which are suspended weighing means or supporting means to hold the elements to be painted, etc.

Another purpose of the invention is to embody a continuous painting device which carries out this method.

The continuous painting device according to the invention cooperates with feeder means by means of which the element to be painted is fed into a substantially closed box-shaped structure which acts as a painting chamber.

The device arranges that the rod-shaped elements to be painted cooperate with conveyors elements such as conveyor belts, roller conveyors, conveyor elements on which are suspended weighing means or supporting means to hold the elements to be painted, etc.

At least two spraying assemblies, each of which comprises a plurality of spray guns delivering paint and variously oriented or orientable according to the conformation of the profile of the element to be painted, are contained within this closed box-shaped structure.

According to the invention at least one assembly to remove, level and spread the first layer of paint applied to the element to be painted is included downstream of the first spraying assembly and upstream of at least one second spraying assembly.

The assembly to remove, level and spread the first layer comprises a plurality of rotary brushes positioned in cooperation with the periphery of the profile of the element to be painted being thus fed.

According to the invention the first spraying assembly has the task of applying a first layer of paint to cover the desired surfaces of the element to be painted and of filling the structural pores and grains on that element.

The brushes of the removal, levelling and spreading assembly positioned downstream of the first spraying assembly have the primary task of removing all the excess paint from the element, both from the flat or substantially flat parts thereof and from its more marked structural grains.

The paint is left intentionally in the shallower pores and grains where the successive drying action of the ultraviolet rays is able to dry the paint in the required manner.

The brushes have also the secondary task of spreading uniformly the paint in a homogeneous manner substantially over the whole surface of the element to be painted.

A second layer of paint is then applied downstream of the removal, levelling and spreading assembly and, being deposited on a surface already covered in a homogeneous and even manner, is distributed evenly over the whole desired profile of the element.

This situation takes place because the surface tension of the liquid paint sprayed on the element to be painted does not meet during its spreading any obstacle caused by a dry surface on the actual element itself.

According to a variant, where the spraying devices are greater and have a higher output and a wider field of application, a second removal, levelling and spreading assembly followed by a third spraying assembly is included downstream of the second spraying assembly.

The painting method according to the invention thus ensures a homogeneous spreading of the paint and enables a substantially even thickness of paint to be achieved over the whole surface and thus prevents the running and build up of paint involved in the methods according to the state of the arts.

This method thus enables paints to be used without a solvent and with a 100% dry residue, together with the

working and environmental advantages arising therefrom.

Moreover, the invention enables a substantially complete recovery to be obtained of the paint sprayed and not deposited on the element to be painted.

The ability to achieve an even thickness dried in the desired manner lessens the honing problems with a great improvement of the quality of the finished product.

According to the invention the removal, levelling and spreading assembly comprises assemblies of brushes positioned in cooperation with the sides to be painted of the rod-shaped element.

These brushes are adjustably positionable according to the conformation of the element to be painted.

According to the invention the brushes carry out not only their specific task of removal, levelling and spreading of the layer of paint but also a task of longitudinal and lateral guiding of the element to be painted during the forward movement of the latter.

According to a preferred embodiment of the invention two brushes are included per each free side of the element to be painted.

According to another preferred embodiment, where there are two brushes per side, each brush rotates in the opposite direction to the adjacent brush and to the opposed brush, this situation being applied at least where there are lateral brushes.

The purpose of this is that, in correspondence with these lateral brushes, the element to be painted is not subjected to any pressure and is merely rested on the conveyor means.

In this case, if the brushes are rotated in the same direction as each other but in the opposite direction to the direction of feed of the element, this situation would exert a braking of the element, whereas if the brushes are rotated in the same direction as the direction of feed of the element, this would cause an undesired forward drawing of the element at a speed greater than the correct speed of feed of the element.

If the brushes are rotated in the opposite direction to each other, their effect counterbalances each other and the element to be painted is borne forward by the mere friction of the feeder means.

According to the invention the brushes are rotated at a high peripheral speed, advantageously at least 4 metres per second, so as to perform an efficient action of removal of the layer of paint.

According to the invention the brushes are associated with means for recovering and recirculating the removed paint; these means for recovering and recirculating removed paint, according to the invention, include circumferential casings positioned in cooperation with the periphery of the relative brush, these casings collecting the paint expelled from the brush by centrifugal force and being conformed to define a channel down which the paint can run.

According to the invention this channel for the running paint is associated with means for the recovering and recirculation of the paint arriving by gravity.

The painting device according to the invention comprises aspiration means associated with means to remove and separate the paint from the air, these latter means making possible a practically complete recovery of all the paint mixed with the air and not fixed to the element to be painted during the spraying step.

The painting device according to the invention comprises also means to recover the paint falling from the element being painted and the paint deposited on the walls and floor of the painting chamber.

The attached figures are given as a non-restrictive example and show a preferred embodiment of the invention as follows:-

- Fig.1 gives a block diagram of the painting method according to the invention;
- Fig.2 is a diagrammatic view of the painting device according to the arrow A of Fig.3;
- Fig.3 is a diagrammatic view of the painting device according to the arrow B of Fig.2;
- Fig.4 is a front view of a rotary brush employed in the device according to the invention;
- Fig.5 is a three-dimensional view of the protective casing of the rotary brush of Fig.4;
- Fig.6 is a diagram of the means that aspirate and recover the paint and are associated with the painting device according to the invention.

A continuous painting device 10 shown in Figs.2 and 3 cooperates in this case with a conveyor 11 advancing in the direction 12 and consisting of a powered roller conveyor comprising a plurality of rollers 13 advantageously made of stainless steel.

The direction 12 of advance is parallel to the longitudinal axis of an element 18 to be painted, which in this case is advantageously a substantially rod-shaped wooden element, such as a strip for a frame, for instance.

The painting device 10 in this case comprises a box-shaped structure 14, which has metallic walls and acts as a closed chamber for the painting operations.

The box-shaped structure 14 contains in sequence, in this case, a first spraying assembly 15, a removal, levelling and spreading assembly 16 and a second spraying assembly 17.

Each spraying assembly 15-17 includes a plurality of spray guns 19, which deliver paint and cooperate with the periphery of the profile of an element 18 to be painted (not shown in Fig.3 for the sake of simplicity of description).

These spray guns 19 can be oriented and be positioned automatically by a servo-mechanism according to the identification of the conformation of the element 18 to be painted.

The first spraying assembly 15 applies a first layer of paint to the surface of the element 18 to be painted (step 20, Fig.1).

This first layer of paint covers the element 18, fills its structural pores and grains and prepares the surface of the element 18 for the successive applications.

The element 18 to be painted undergoes, downstream of the first application 20, a step 21 of removal, levelling and spreading of the first layer of paint; this step 21 is performed by the removal, levelling and spreading assembly 16, which comprises in this case three pairs of brushes 25, each pair consisting of two brushes rotatable in the opposite direction to each other.

In particular, there are included a pair of contrarotatable brushes 25a, which cooperate from above with the element 18 to be painted, and two pairs of contrarotatable brushes 25b, which cooperate laterally, one per each side, with the element 18 to be painted. These brushes 25 are driven by respective motors 26.

The reciprocal contrarotation of the brushes 25, whether brushes 25 side by side, or brushes 25 opposite to each other, performs also the task of guiding the element 18 to be painted during its forward movement.

The action of the brushes 25 on the element 18 to be painted causes a removal of the excess paint, particularly from the deeper and higher grains, and leaves the element 18 to be painted substantially wetted by a very thin layer of paint spread in an even and homogeneous manner.

According to the invention each brush 25 cooperates peripherally with a protective casing 27 which recovers the paint removed from the surface of the element 18; the casing 27 surrounds a substantial portion of the circumference of the relative brush 25 and includes in its lower part a conformation substantially such as that of a gutter 28.

The paint removed from the surface of the element 18 by bristles 42 of the brushes 25 is thrown by centrifugal force against the inner walls of the casing 27, whence the paint descends by gravity and is accumulated within the gutter-shaped conformation 28.

This gutter-shaped conformation 28 is advantageously inclined upstream and has its ends associated with means that recover the paint, such as the small tubes referenced with 29 in Fig.5.

These small tubes 29 convey the recovered paint towards suitable collection means, from which the paint is re-fed, after possible filtration and purification treatments, to the spray guns 19.

A second spraying assembly 17 having a conformation substantially analogous to that of the first spraying assembly 15 is included in this case downstream of the removal, levelling and spreading assembly 16.

In this case the second spraying assembly 17 has the task of applying 22 a second layer of paint to the element 18 to be painted.

This second layer of paint is applied to a surface wetted in a substantially homogeneous and even manner, thus forming a substantially continuous and constant thickness without dripping, build-ups or surfaces lacking paint.

The element 18 leaving this second application of paint 22 is subjected to an in-line drying step 23 with the application of ultraviolet rays.

According to a variant, which is shown with lines of dashes in Fig.1, a second step of removal, levelling and spreading 21 is carried out downstream of the second spraying assembly 17 and is followed by at least one third application 24 of a layer of paint and then by a drying step 23.

The painting device 10 according to the invention comprises aspiration means performing a re-circulation of air and a recovery of the paint sprayed within the painting chamber.

In this case the aspiration means comprise a first aspiration pipe 30, the intake 31 of which is associated with a collection vessel 32 positioned substantially below the spray guns 19 in the spraying assemblies 15-17.

The air mixed with paint is aspirated by the action of a motor 33, which drives a fan 34, and the air is delivered into a separation cyclone 35, within which a substantial separation of the air from the paint takes place.

This separation is induced by making the aspirated air (referenced with 36), carry out a substantially helicoidal path, which causes an intense flapping action that leads to separation of the paint from the air.

The air separated from the paint is conveyed into a column 37, whence the flow of air is discharged through a second pipe 38 and filtered in a collector 39, which makes possible a recovery of the residues of paint still mixed with the air.

According to a variant a part of the flow of air is first filtered by a filter 40 and is then re-delivered into the painting chamber through a third pipe 41.

Besides the filtration system described above, the painting device 10 according to the invention can be associated with other filtration methods, such as those, for instance, which provide a dry filtration by expansion of the current of air and a consequent variation of the speed.

Claims

1. Method for the continuous painting of moving elements, which is suitable advantageously, but not only, for the painting of elements of a rod-shaped type being fed along their longitudinal axis, such as strips for frames in particular, the method being especially suitable for the painting of elements having a variously shaped or moulded profile, the method including one or more applications of paint on the element (18) to be painted, a brushing step and a step (23) of drying with ultraviolet rays, the paint being of a photosensitive type with a substantially 100% dry residue, the method being characterised in that it comprises in sequence a first step (20) of application of a first layer of paint on the element (18) to be painted, a step (21) of removal, levelling and spreading of that first layer of paint on the

surface of the element (18) to be painted and at least one second step (22) of application of a second layer of paint, these three steps (20-21-22) being followed by the step (23) of drying with ultraviolet rays.

2. Method as in Claim 1, in which the step (22) of application of a second layer of paint to the element (18) to be painted is followed by at least one second step (21) of removal, levelling and spreading of the layer of paint and a third step (24) of application of a third layer of paint.

3. Method as in Claim 1 or 2, in which the step (21) of removal, levelling and spreading is carried out with rotary brushes (25) rotatable at a peripheral speed of at least 4 metres per second.

4. Method as in any claim hereinbefore, in which the rotary brushes (25) perform also a task of lateral and longitudinal guiding of the element (18) to be painted during the forward movement of the latter (18).

5. Method as in any claim hereinbefore, which includes the transfer by centrifugal force of the paint removed during the removal, levelling and spreading step (21) to casing means (27) and the transfer of that paint therefrom to storage and re-usage means.

6. Device for the continuous painting of moving elements, which is suitable advantageously, but not only, for the painting of elements of a rod-shaped type, such as strips for frames in particular, which are fed along their longitudinal axis, the device (10) being especially suitable for the painting of elements (18) having a variously shaped or moulded profile, the device (10) cooperating downstream with means for drying with ultraviolet rays and comprising means (11) for the continuous feeding of the elements (18) to be painted, the device (10) including a box-shaped structure (14) defining a substantially closed painting chamber, within which are contained at least two spraying assemblies (15-17), each spraying assembly (15-17) comprising a plurality of adjustably positionable spray guns (19) to deliver paint, the device (10) being characterised in that it comprises at least one first spraying assembly (15), at least one first assembly (16) for the removal, levelling and spreading of the layer of paint and at least one second spraying assembly (17) arranged in sequence.

7. Device as in Claim 6, in which the removal, levelling and spreading assembly (16) comprises a plurality of rotary brushes (25) positioned in cooperation with the periphery of the element (18) to be painted.

8. Device as in Claim 7, which includes a pair of brushes (25) for each free side of the element (18) to be painted, these brushes (25) performing also the task of lateral and/or longitudinal guiding of the element (18) to be painted during the forward movement of the latter (18).

9. Device as in Claim 8 in which the brushes (25) positioned opposite to each other in relation to the element (18) to be painted and/or the brushes (25) positioned side by side rotate in the opposite direction to each other.

10. Device as in any of Claims 6 to 9 inclusive, in which the brushes (25) are rotated at a peripheral speed of at least 4 metres per second.

11. Device as in any of Claims 6 to 10 inclusive, in which there are included in sequence at least one second removal, levelling and spreading assembly (16) and at least one third spraying assembly downstream of the second spraying assembly (17).

12. Device as in any of Claims 6 to 11 inclusive, in which the brushes (25) cooperate peripherally with protective casing means (27) that retain paint, these casing means (27) being associated with means (29) that recover and recirculate paint.

13. Device as in Claim 12, in which the casing means (27) have a terminal gutter-shaped conformation (28) with the task of retaining, collecting and conveying paint.

14. Device as in any of Claims 6 to 13 inclusive, which comprises aspiration means (30) associated with means (35) that separate the paint component from the air, with filtration means (40) and with discharge means (38).

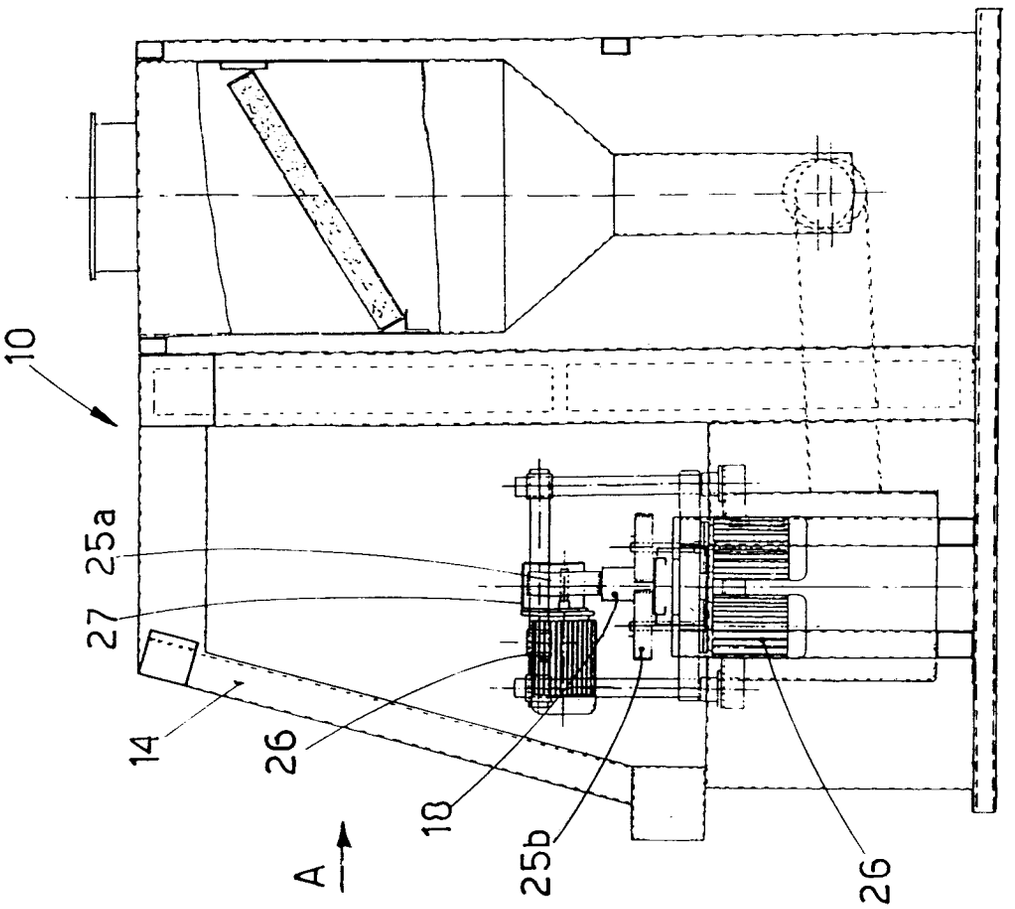
10
25a
27
14
26
18
25b
A
26

fig.3

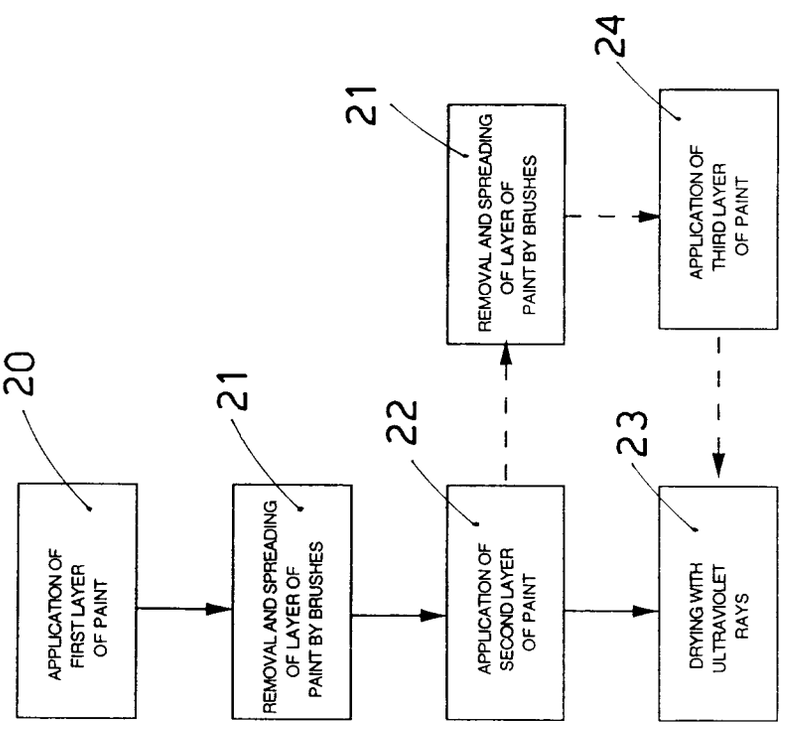
20
APPLICATION OF FIRST LAYER OF PAINT
21
REMOVAL AND SPREADING OF LAYER OF PAINT BY BRUSHES
22
APPLICATION OF SECOND LAYER OF PAINT
23
DRYING WITH ULTRAVIOLET RAYS
21
REMOVAL AND SPREADING OF LAYER OF PAINT BY BRUSHES
24
APPLICATION OF THIRD LAYER OF PAINT

fig.1

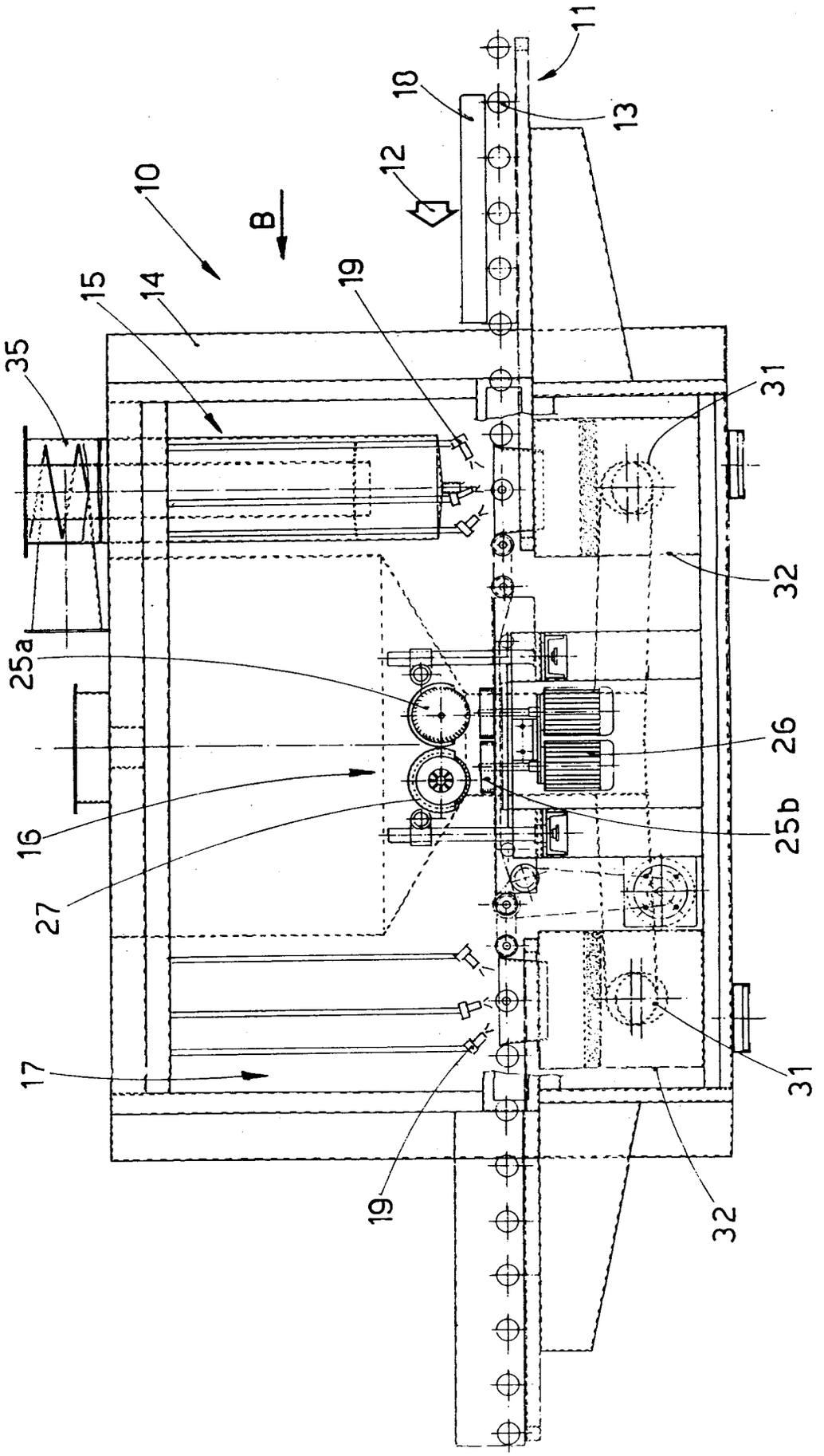

fig.2

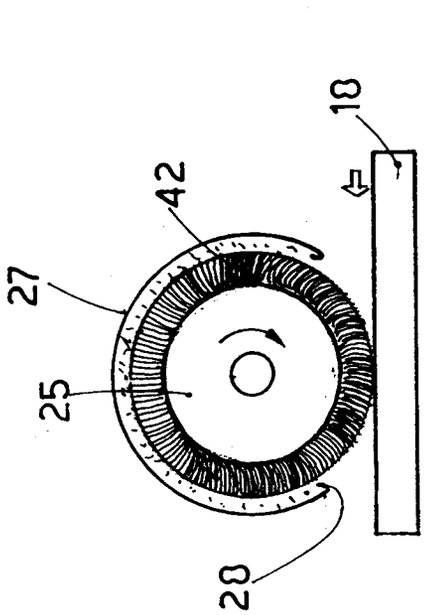

fig.4

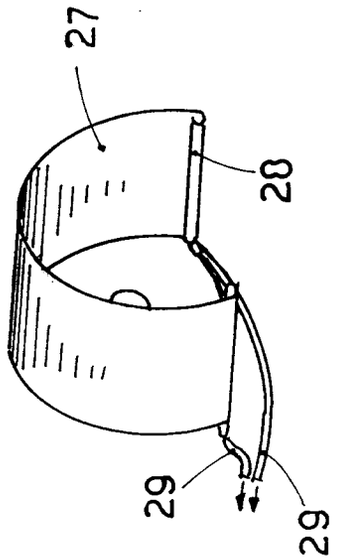

fig.5

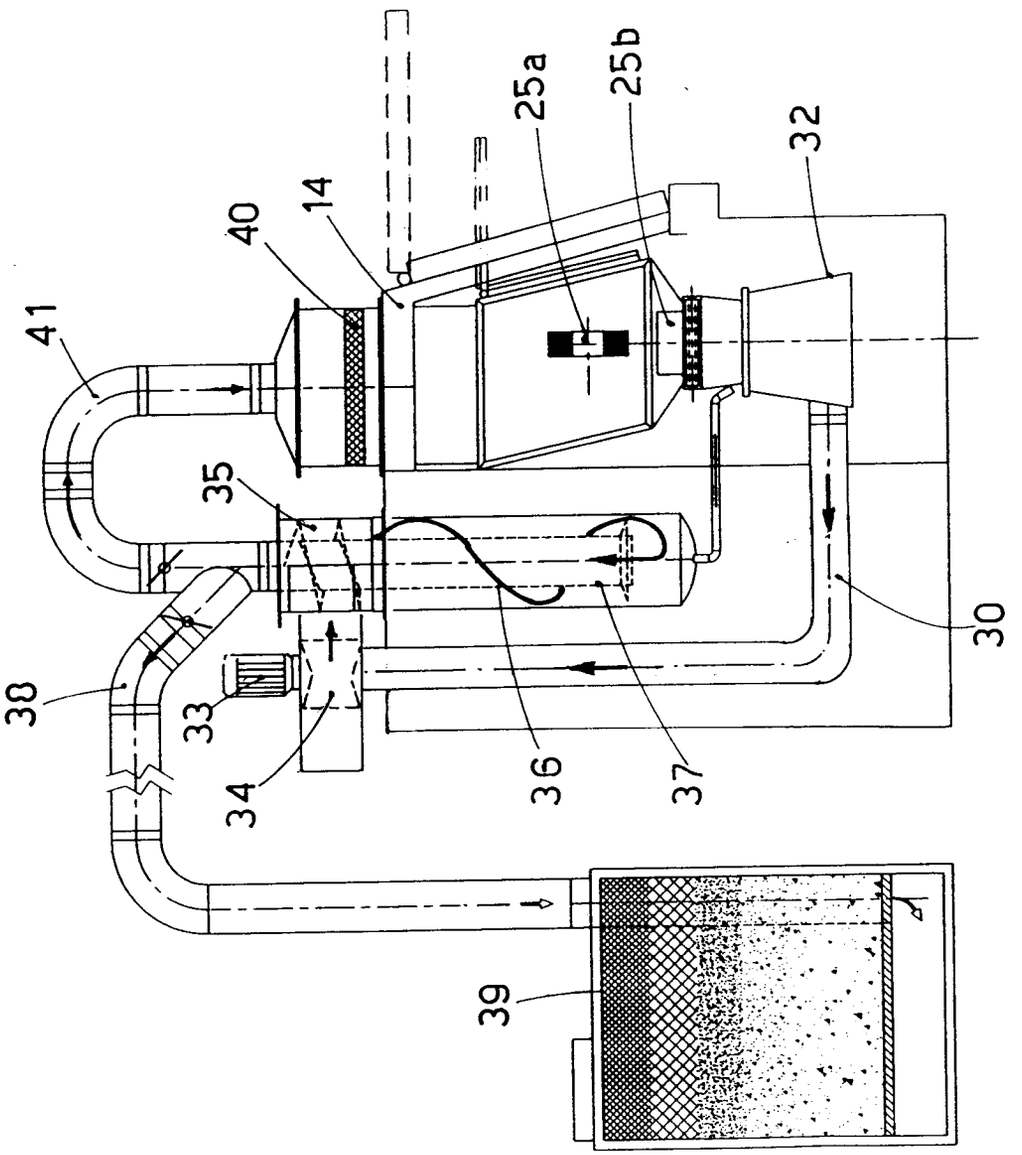

fig.6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 10 0672

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	PATENT ABSTRACTS OF JAPAN vol. 012 no. 048 (P-666) ,13 February 1988 & JP-A-62 195582 (RHYTHM WATCH CO LTD) 28 August 1987, * abstract * ---	1,6	B05D3/12 B05D3/06 B05D1/38
A	US-A-2 971 856 (E.A.LAURING) 14 February 1961 * the whole document * -----	1,6	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B05D
B05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 March 1996	Brothier, J-A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)